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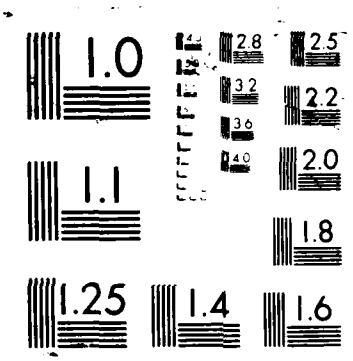
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Kinetic studies of ground and excited states of NF and PF radicals were carried out to determine radiative lifetimes, branching ratios, and quenching rate constants. Similar studies were performed on the diatomic halogens and interhalogens in order to identify and study the dynamics of ground and excited states in order to evaluate the laser potential of these species.

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QUANTUM-RESOLVED DYNAMICS OF HALOGENS AND INTERHALOGENS AND STUDIES OF NF AND PF RADICALS

Kinetic studies of ground and excited states of NF and PF radicals were carried out to determine radiative lifetimes, branching ratios, and quenching rate constants. Similar studies were performed on the diatomic halogens and interhalogens in order to identify and study the dynamics of ground and excited states in order to evaluate the laser potential of these species.

Highlights of major achievements of the program include the following:

The reaction H plus NF(a) has been shown to yield N ^2D + HF. The formation of excited molecular states from the H + NF_2 reaction has been investigated. The reaction has been shown to give NF(a) with a branching ratio greater than or equal to 0.9. Intense N_2 (B-A) and Lyman-Birge-Hopfield emission is believed due to the formation of the relevant excited states in the highly exoergic reaction of N ^2D atoms with NF(a). N ^2D + H_2 is believed to be the precursor reaction of triplet and singlet states of NH. The lifetime of NF(b) has been determined using a pulsed discharge technique. NF(b) is formed by the reaction of Ar $^3P_{2,0}$ metastables with NF_3 or N_2F_4. The first study of state-to-state vibrational transfer in excited BrF(B) was reported. State-selective chemistry of the NCl free radical has been investigated using collision-free mass spectrometry. The precursor of ground state NCl (X triplet sigma) and excited state NCl (a singlet delta, b singlet sigma) is the rapid exoergic reaction Cl + N_3 = NCl + N_2. While ground state NCl does not react at 298K with Cl_2, excited state NCl(b) forms NCl_2 by reaction with Cl_2 in an exoergic step. Radiative lifetimes and quenching data have been determined for the A singlet pi and b prime triplet pi states of SnO.

Among the results of this research program are the scientific reports listed below.

1. "Non-Reversed Source of Br Atom Resonance Radiation and its Application to the Measurement of Br Atom Concentrations," M.A.A. Clyne and D.J. Smith, J. Chem. Soc. Faraday II 74, 263 (1978).

2. "Quantum-Resolved Dynamics of Excited States. Part 1. Predissociation in the B $^3\Pi$ (0+) State of BrF," M.A.A. Clyne and I.S. McDermid, J. Chem. Soc. Faraday II, 74, 644 (1978).

3. "Quantum-Resolved Dynamics of Excited States. Part 2. Stable Levels of the B $^3\Pi$ (0+) State of BrF," M.A.A. Clyne and I.S. McDermid, J. Chem. Soc. Faraday II, 74 664 (1978).

4. "Studies of BrCl by Laser-Induced Fluorescence. Part 1. Excitation Spectra and Predissociation in the Excited B $^3\Pi$ (0+) State," M.A.A. Clyne and I.S. McDermid, J. Chem. Soc. Faraday II, 74, 796 (1978).

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5. "Studies of BrCl by Laser-Induced Fluorescence. Part 2. State-Selected Kinetics in the Excited $B\,^3\Pi(0^+)$ State of BrCl," M.A.A. Clyne and J.S. McDermid, J. Chem. Soc. Faraday II, 74, 807 (1978).

6. "Quantum-Resolved Dynamics of Excited States. Part 3. Collision-Free Lifetimes of BrF(B)," M.A.A. Clyne and J.S. McDermid, J. Chem. Soc. Faraday II, 74, 1376 (1978).

7. "Kinetic Spectroscopy in the Far Vacuum Ultraviolet. Part 5. Oscillator Strengths for the 3s, 4s, 5s, 3d, and 4d ^4P_J - $2p^3\,^4S^0_{3/2}$ Transitions in Atomic Nitrogen," M.A.A. Clyne, S. Jaffe, and P.D. Whitefield, J. Chem. Soc. Farraday II, 76, 369-382 (1980).

8. "Laser-Induced Fluorescence of the BO and BO_2 free radicals," M.A.A. Clyne and M.C. Heaven, Chem. Phys. 51, 299-309 (1980).

9. Reactions Forming Electronically Excited Free Radicals. III. Formation of Excited Molecular States in the H + NF_2 Reaction," C.T. Cheah, M.A.A. Clyne, J. Photochem. 15, 21-35 (1981).

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